

The Passive Monitoring Program for Ozone

Program Introduction

For the last several years the Air Resource Division's Research and Monitoring Branch (RMB) has been testing passive ozone samplers that are low-cost, simple to use, and do not require power to operate. The devices are similar to filter samplers in that they provide integrated measurements and the actual analysis is done later at a laboratory. After testing these devices at different parks and under different field conditions, we are now confident that the passive samplers can provide basic ozone exposure information.

RMB proposes to use the passive ozone samplers in a monitoring program to determine ozone exposure levels in all Class I parks that have not had ozone monitoring and a select number of Class II parks. The RMB will provide technical assistance, the sampling devices, lab analysis, data processing, and data reports. The parks would need to provide an operator that could visit the monitoring site once a week, a suitable monitoring site, and an interest in the results. Monitoring would involve exposing the passive samplers for one week periods, retrieving the samplers, and mailing them to the analysis contractor. Sampling would continue on a weekly basis for the "ozone season" (3 to 5 months).

Background

Air pollution is an external threat to the resources of many National Parks. Since the early 1980's the Air Resources Division has operated a nation-wide network of continuous ozone analyzers to monitor ozone levels and trends in the NPS units. A plan was formulated in 1991 to have a series of baseline and trends sites that eventually would provide monitoring data at each of the Class I areas and several Class II areas (<http://www.nature.nps.gov/ard/gas/network.htm>). Since funding has not been adequate to complete the plan, monitoring has been delayed at a number of park units. The passive ozone monitoring program presented here provides a low cost means to immediately provide basic ozone exposure data for those areas that have not yet had ozone monitoring.

How can the results from the passive samplers be used and interpreted? Because the measurement is an integrated ozone exposure over a one-week period, the results can not be used to determine non-attainment of the EPA ozone standards which are now based on 8-hour ozone levels. However, the measurements can tell if ozone exposures are high enough to present a risk to plant and animal resources. Some researchers believe that extended high ozone exposures can be as harmful as short duration ozone concentrations that exceed the old 120 ppb (parts per billion) national standard. EPA recently changed the national ambient ozone standard to the 4th highest 8-hours average ozone greater than 85 ppb for both human health and welfare (i.e. resources). And recent research on ozone effects on plants has reported that the best statistic for relating ozone concentrations to plant injury is the integrated seasonal ozone exposure (called SUM0)..

The passive samplers can provide basic information on the ozone exposures and thus provide a baseline by which the need for additional, more intensive, monitoring can be judged. Passive sampler measurements over several years can be used to determine trends in ozone pollution at a specific park and estimate the maximum expected annual ozone concentrations. Also, estimates could be made of how representative the next closest continuous ozone monitors are for air within that park. The results from the passive ozone samplers would reduce the uncertainty of how bad ozone pollution is in the parks and provide the first real observations for the park units involved in the program.

Details

The RMB has selected the Ogawa passive sampler for use in NPS units. The Ogawa samplers consist of a double-sided filter holder that is mounted on a "badge" with a clip on the back. Inside the filter holder are two nitrite coated filters. When the nitrite coated filters are exposed to the air, ozone diffuses through the

end-caps and reacts with the nitrite to form nitrate. To protect the samplers from direct contact with water, a rainshield PVC plastic is used to protect the samplers in field use (see Figure 1).

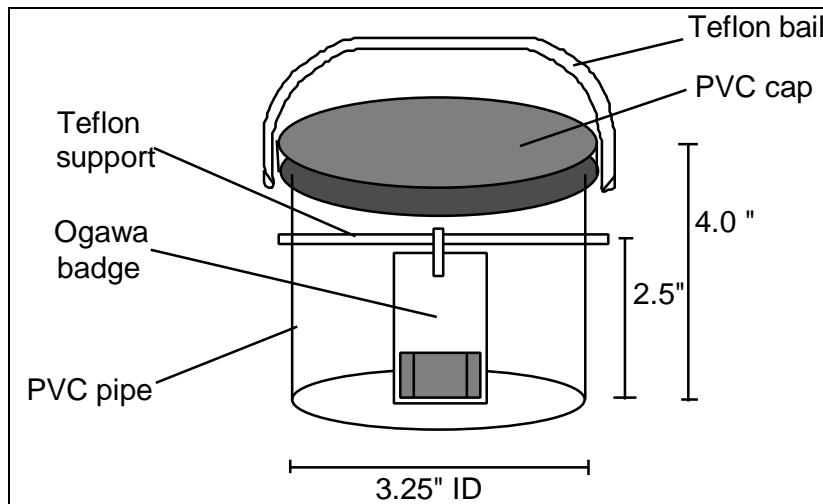


Figure 1. Diagram of the rainshield with the passive sampler “badge” inside. The rainshield was made from 3-inch diameter PVC drain pipe, a PVC end-cap, and Teflon tubing for supports

The passive samplers are shipped to the field sites inside amber plastic vials and zip-closure plastic bags. When the field operator removes the sampler from the protective containers the exposure time begins. After a measured time of exposure, the samplers are returned to the shipping containers and sent to a lab for analysis. At the lab, the filters are removed in an ozone-free atmosphere, the filter extracted with water, and the extract analyzed by ion chromatography for nitrate ion. The weight of the nitrate is used to calculate the ozone exposure dose or the average ozone exposure determined by dividing ozone dose by the exposure time.

Siting criteria

Where the ozone measurements are made is as important as how. In general, the measurement site needs to be representative of the regional air. Thus, a clearing of 50 meters that is not near heavily traveled roads, parking lots, or combustion sources is needed. The site should have reasonable access so that travel time by the operator is not excessive and yet be unintrusive to the visitor and be secure enough that samplers are not disrupted. Park personnel will need to identify potential sites and the final site chosen will need to be documented for later reference.

Sampling periods

The exposure period for the passive samplers is normally one-week. Duplicate samplers would be deployed on Tuesday morning, for example, and the site operator would return the next Tuesday to replace the samplers with another set. Depending on operator availability and the expected duration of the ozone season, sampling will be for 3 months to 5 months.

Sampling procedures

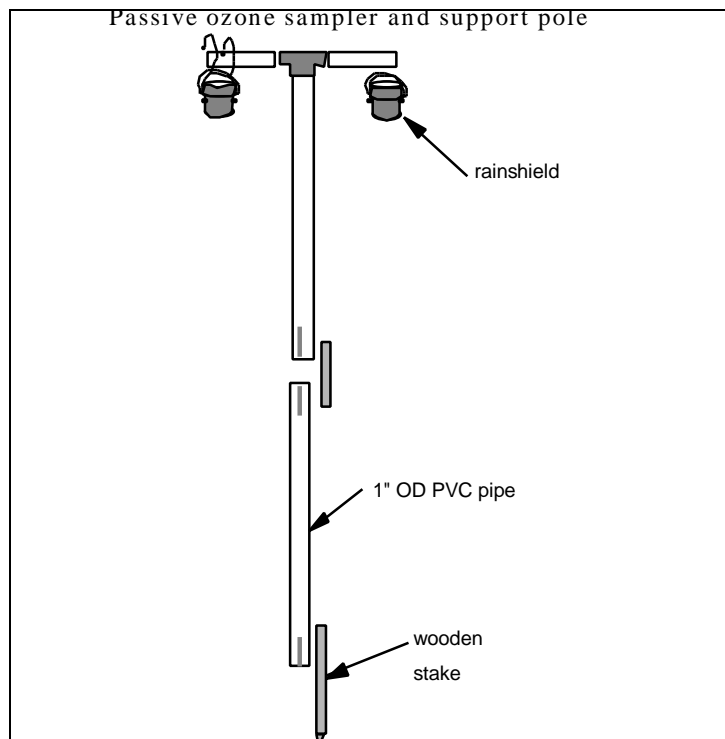
- Shipping

The passive samplers are shipped to the Park once a month. Each shipment contains enough samplers for each exposure period during the month plus “blanks” that are not exposed. Samplers not in use are stored in a room temperature location out of direct sunlight. At the end of the month park personnel will return the exposed samplers and associated blanks in the shipping box to the analysis lab using a prepaid shipping label.

- Sampling devices

The on-site equipment consists of a pvc plastic-pipe “tower” and a pair of pvc rainshields that remain at the sampling site. The passive sampler devices come with badge-clips to attach the samplers inside the rainshields.

Figure 2. Diagram of the unassembled parts of the 10 foot sampling pole and sampler rainshields. This simple, light-weight system can be carried into the field easily and assembled on-site. The plastic pole is painted gray/green to reduce visual impact.



- **Sample handling/log sheets**

Each plastic vial containing a passive sampler will have a label where the date and times will be recorded. In addition, the dates, times, sample numbers, and local observations will be recorded on a log sheet. The duration of exposures is critical information that allows the ozone exposure to be calculated.

Data reporting

After the laboratory analysis has been completed, the lab results, exposure times, and log sheets will be collected together at the ARD Data Processing Center where the actual ozone concentrations will be calculated. Monthly preliminary ozone concentrations will be reported back to the park for review. At the end of the season, all the ozone data will be reviewed and additional quality control checks made. After making any needed adjustments, a summary of ozone concentrations will be reported for each Park. Results will be compared to the nearest continuous ozone monitors, to national ozone standards, to other nearby parks, and to regional trends. Predictions of the maximum hourly ozone may be included. These results will provide baseline information on ozone pollution in the participating parks and assist in decisions on the need for additional continuous ozone analyzer monitoring.

Sample results, standard operating procedures, and presentations can be obtained from our web site at <http://www.nature.nps.gov/ard/gas/passives.htm> .

Costs and operator time requirements

The Air Resources Division will provide the passive samplers and equipment, laboratory analysis, shipping, data handling and reporting, field operating procedures, and technical assistance at no cost to the park. The park must provide assistance in siting and a site operator that can visit the site once a week at about the same time of day each visit. Actual time required of the site operator will be travel time to the site and about one hour per week for the sample handling.

Statement of interest required

Each of the Class I areas eligible for this program will be contacted directly. A short statement from each interested park unit is requested stating how this pollution monitoring fits into their resource preservation plan and affirming the availability of a site operator and park resources to do the sampling.

The Program Coordinator is Dr. John D. Ray of the Air Resources Division, Research and Monitoring Branch, who may be contacted through NPS cc:mail, phone at (303) 969-2820, or fax at (303) 969-2822.

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